Space Weather Technical Forecast

Issued on Thursday, 24 August 2023 at 13:14 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Now reduced Slight Chance of G1 in current UTC day. Ongoing Chance of R1 throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured by GOES16 is currently Low, with occasional low-level C-class flares on a background that has declined into B-class. The peak flare during the period was a C3.9 flare peaking at 23/1407UTC from AR3405 in the northwest - a Cso/Beta with a small developing leading spot ahead of the symmetrical main trailing spot.

There are now up to six sunspot regions on the disc, with AR3404 having decayed to plage as a new unnumbered Bxo group has developed to the immediate northeast of the nominally large and complex AR3413. This group shows an east-west orientated magnetic netural line, and although it has a relatively straightforward Beta classification, it has undergone some significant spot growth in its northern half in recent hours and is drawing attention. Also of note is the large AR3415 in the southeast, which perhaps takes the form of a large Delta, although its slight fading tendency and the relatively large separation within the penumbra may be helping to mollify this group's activity. Other regions on the disc were stable and apparently simpler, while AR3404 faded entirely to plage.

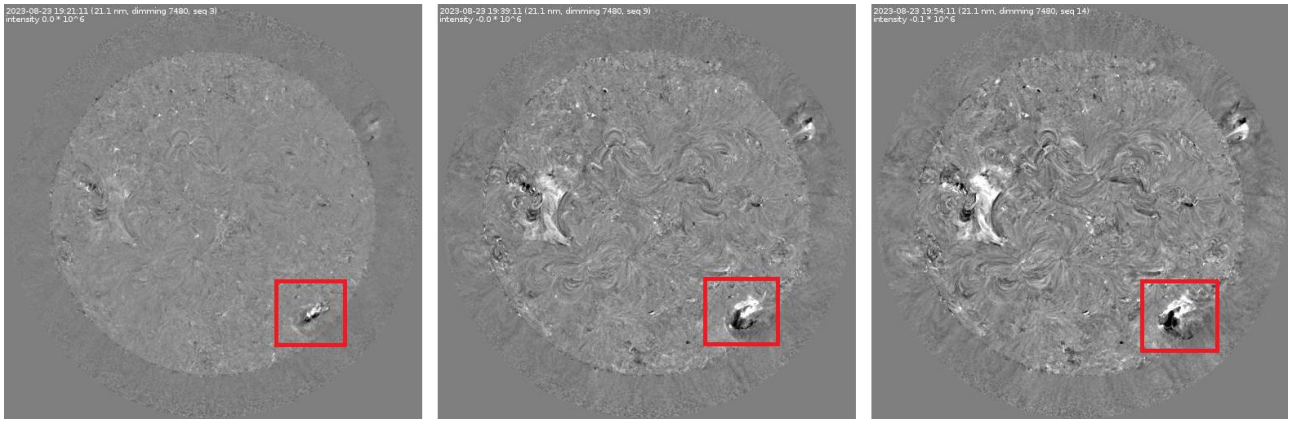

Figure 0: SIDC ROB-processed AIA211 time integrated dimming of a filament eruption from the southwest disc around 23/1930UTC. The resulting CME has been analsyed as a tentative miss.

There were a few potential Coronal Mass Ejection (CME) progenitor events of note in the period. A large 'C-shaped' EUV dimming and C2.5 flare occurred from around AR4313 at 23/1616UTC - no subsequent CME was noted. A filament eruption around 23/1930UTC from the southwest disc manifested in UTC evening coronagraph imagery as a visually southward-directed CME near the Sun-Earth line. This appears to have pivoted about its eastern anchor point - hence the apparently mainly southward rather than southwestward trajectory. This event has been analysed and is

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expected to miss, passing below the ecliptic from limited imagery. Finally, at the very end of the 24-hour window, a large prominence eruption appeared to be in progress on the northeastern limb. This is not yet visible in coronagraphs, however any Earth-directed component is considered very unlikely. No other potentially Earth-directed CMEs were identified.

Solar Wind / Geomagnetic Activity: Solar wind speeds, as measured by DSCOVR at L1, persisted at Slightly Elevated levels in the probable tail of a negative polarity fast wind, with the phi angle accordingly towards the Sun throughout.

The solar wind speed fell very gradually through the lower 400s of km/s, with the density steady in single figures ppcc over the same interval. The IMF was steady at or below 6nT, while the north-south component ranged between 5 and -3nT, with a mainly co-aligned bias with Earth's field.

The net effect of the above solar wind measures was for provisional Quiet geomagnetic activity throughout.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at Background levels.

GOES16 high energy (greater than 2MeV) electron flux was largely Moderate, with a diurnal peak near 350pfu around 18UTC. The associated 24-hour fluence was well below the Active level, with a flat trend and an observed value of 1.24e7 integrated pfu at 24/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar Activity is expected to be generally Low, but with a continuing Chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs that feature in the forecast. Up to two fast wind streams should materialise - the first imminent from CH39/+, and presenting a Slight Chance of G1 within the remainder of the current UTC day. After a lull towards quieter conditions, a second, smaller peak in risk is possible from CH38/+ by the end of the upcoming UTC weekend.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at Background levels.

High energy electron flux should show an eventual rise after an imminent fast wind, however the magnitude of this is not expected to be sufficient to greatly increase electron populations at GEO. Even at peak this UTC weekend, the associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

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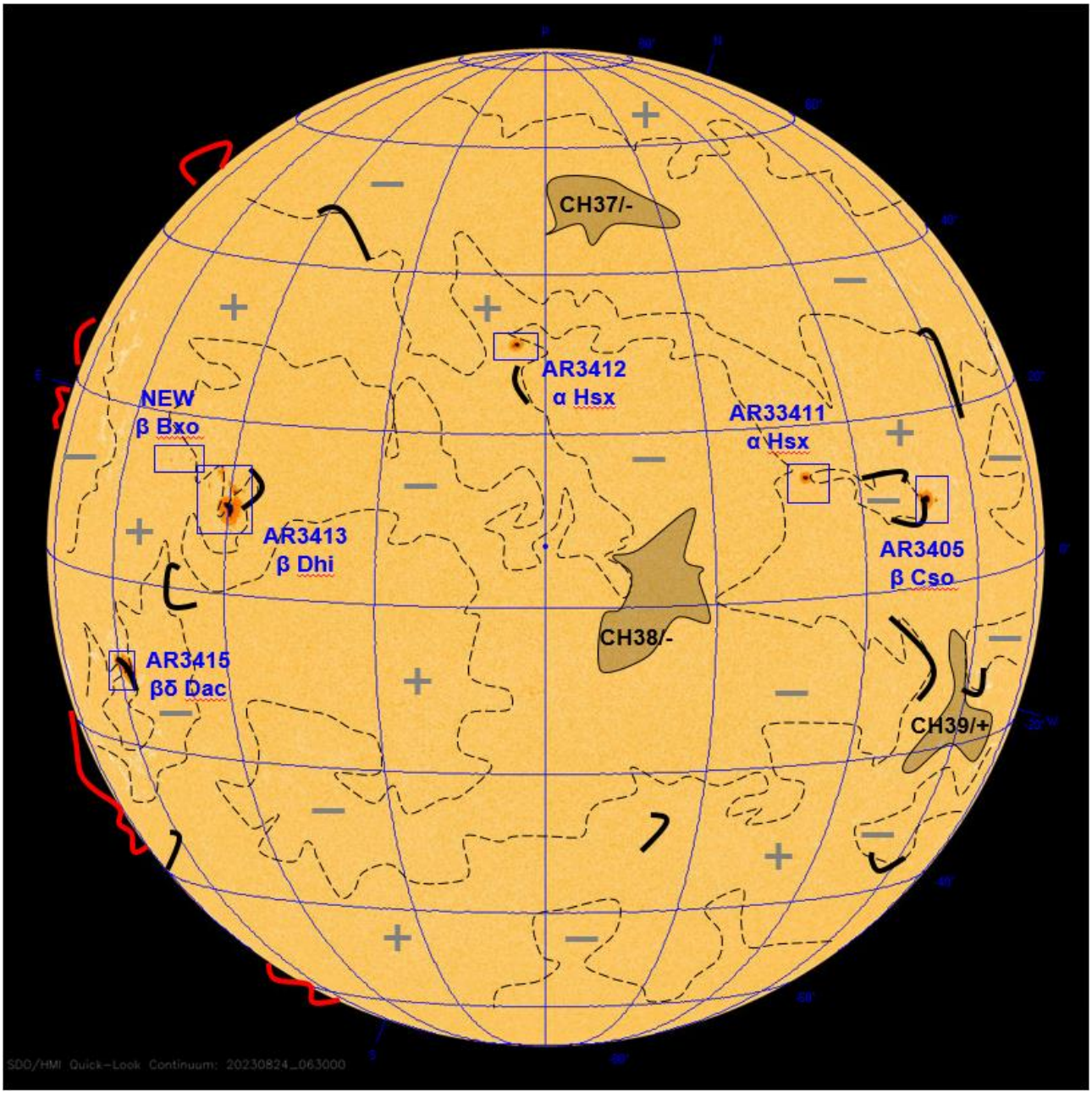
Figure 1. Solar Analysis Valid 24/0630UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the forecast. A filament eruption around 23/1930UTC from the southwest disc (adjacent to a similar event from the same magnetic neutral line at 23/0230UTC) is also expected to miss, the latter apparently passing below the ecliptic from limited imagery.

The coronal hole forecast is relatively low confidence, but comprises two parts: the imminent CH39/+; and also CH38/- for the outlook.

CH39/+ is an apparently small positive coronal hole in the southwest disc, but due to bright flux looping nearer SDO's line of sight (on AIA211 and 193, for example) the extent of this feature is uncertain. 27-day persistence is contaminated from a CME arrival, so despite the coronal hole being present on the previous rotation, confidence is reduced.

The main part of the awaited CH39/+ is currently passing 70W, while the northern promontory that is more likely to impinge on Earth appears to have a leading edge around 60W as of 24/0630UTC. While the emanating flux is chaotic to a degree, we can roughly infer a 400km/s speed were it to arrive imminently, i.e. below previous speed expectations but perhaps nearer MOSWOC Enlil's current thoughts (which may now be coming into line after a turbulent past working week).

Regarding immediacy, there is currently no clear signal of any arrival in either STEREO A MAG or PLASTIC data, nor ACE EPAM LEMS, although none of these would offer much of a forewarning (if any). All considered, these factors have correspondingly led to a small drop in the day one risk to a Slight Chance of G1, with Unsettled activity nevertheless Expected.

From here, after a relatively brief tenure, a lull of 36 hours or so should follow, before the more assured incidence of a fast wind from CH38/- to round out the four-day forecast period. While more certain, the negative polarity of this feature should serve to limit its effects, with a lower peak of Slight Chance of G1 at the end of the UTC weekend.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	1	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Latest AIA 211 (right) and that of four days ago showing coronal hole configurations at those times. Assuming a 400km/s speed for CH39 would track back to a source akin to the left-hand

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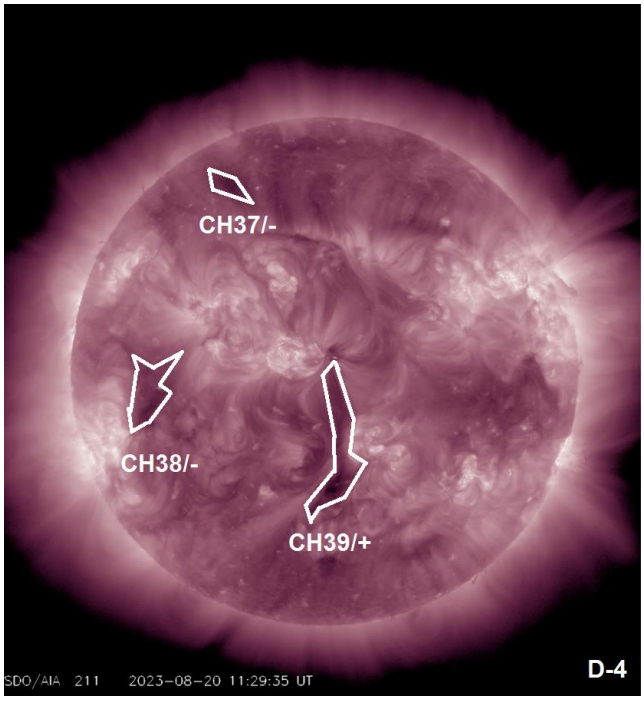
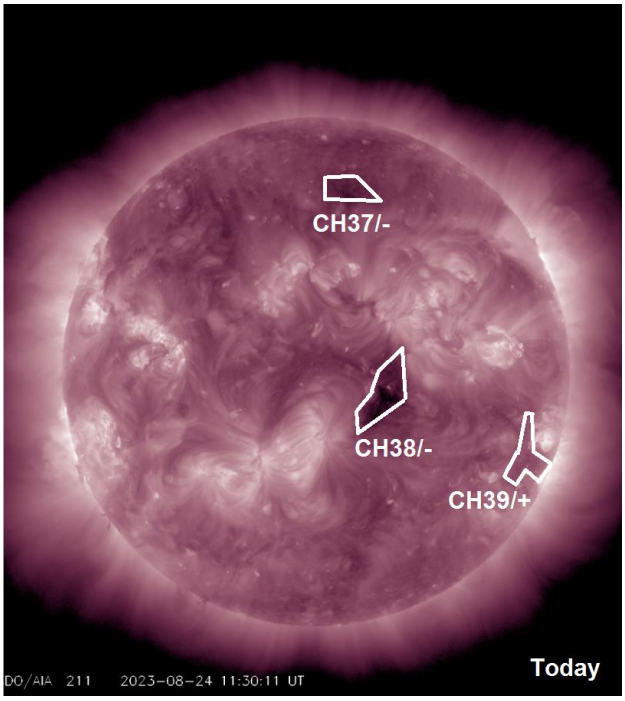
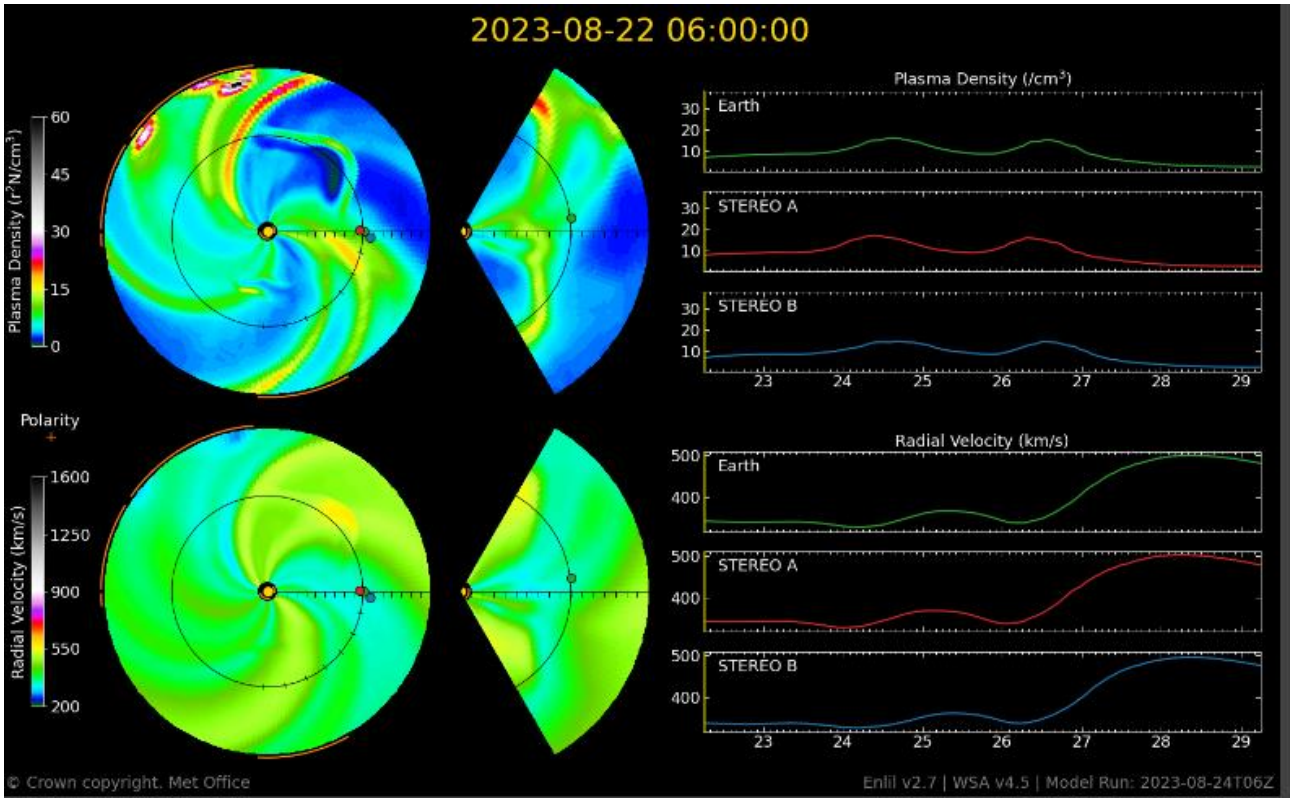
image, with its current appearance masked by EUV flux loops. Also shown below this is the latest MOSWOC Enlil run, which may now be coming into line regarding future coronal holes, with the small initial peak now tentatively accepted. The larger magnitude CH38/- seems likely, even if geomagnetic activity is no less muted for it being of the wrong polarity to connect effectively at this time of year.







Radio Blackouts - X-Ray Flares:

Activity is currently Low, perhaps unexpectedly so given the nominal complexity of the eastern

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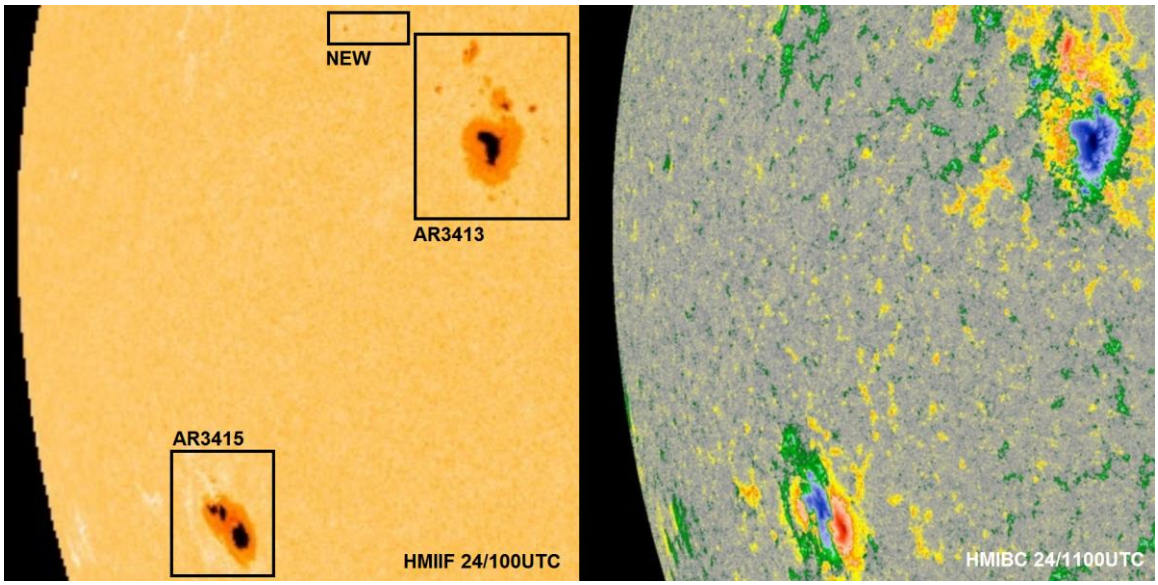
solar hemisphere sunspot groups. There is at present then, an uneasy truce between what appear to be relatively high daily Chances of M-class activity, but also a GOES16 X-ray trace that is often languishing in B-class.

The risk of M-class is still felt to be a current threat - AR3415 appears given the current viewing angle to comprise one large Mount Wilson delta spot - apparently with the constituent umbrae too far apart to warrant activity, but with this poised to change with very little development. Also of note is AR3413 to its northwest, which is a more straightforward Beta group, but shows both more shear potential for its orientation, but also a tendency toward proliferation of spots in recent hours.

Regarding forecast trends, no significant returning regions are due, although there is perhaps some bright flux on the current southeastern limb hinting at a region here. Of the front side groups, only AR3405 is due to leave the disc - at the very end of the coming four days. Because this is the only region to have produced an M-class flare in the past week, its departure is marked by a slight drop in probabilities at the very end of the forecast, with any compensatory eastern limb arrivals uncertain.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	25	25	25	20
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Latest HMIIF and HMIBC imagery, showing the current complexity of two of the largest occupants of the disc.



Solar Radiation Storms - (High Energy Protons):

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High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at Background levels.

The western solar hemisphere is currently mainly occupied by symmetrical simple dipoles or else unipolar groups. There is however a muted slight day-on-day increase in the chances of S1 or greater - this as a result of the usual westward progression of the (nominally) more potent western solar hemisphere groups, with AR3415 and AR3413 the main contributors to this.

Radiation Storms	**Level (cm^{-2} sr^{-1} s^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ S1**	No	1	2	2	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2 MeV) electron flux observed by GOES16 is currently showing a diurnal oscillation between Normal Background and Moderate levels. Any fast wind enhancement(s) both in the near term and over the UTC weekend are likely to suppress GEO observed flux to Normal Background, but with an increasing likelihood of returning to Moderate and perhaps High levels as a result further into the four-day period.

The associated 24-hour fluence is expected to persist below the Active level to start, but with an increasing trend is expected day two (Friday 25 August) onwards, but with the risk of breaching the active level still low. MOSWOC REFM currently looks to be providing reasonable guidance, pending the details of possible future HSS enhancement.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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